Using Brain States to Predict Behavior
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Over the past few decades, noninvasive neuroimaging (such as EEG/ERP, fMRI, and MEG) has led to a number of discoveries about the structure and function of the brain in domains such as perception, cognition and emotion. While collaborations between physicians, psychologists, and neuroscientists have yielded numerous contributions to our understanding of basic processes in the brain, many researchers are now directing their efforts to developing predictive models that may have an impact in educational and clinical practices.

A review article recently published in Neuron by Dr. John Gabrieli and colleagues at the Massachusetts Institute of Technology describes a number of studies that have used brain state information to predict future behavior in a diverse range of contexts. Predictive models using brain states (also called neuromarkers by the authors) have shown great promise in predicting the development of reading ability in children, language and math learning, future drug and alcohol use in teens, likelihood of relapse in addicts, and responses to pharmacological or behavioral treatments.

To develop an effective predictive model, the authors suggest implementing a three-stage strategy. In the discovery stage, researchers explore associations and test a-priori hypotheses between baseline brain states (also called neuromarkers by the authors) and behavioral outcomes. In the cross-validation stage, researchers can use cross-validation routines to develop a prediction model. A typical cross-validation routine consists of partitioning a dataset into training and test subsets, building a model where the training data is used to predict the test subset, and repeating the process using different partitions. Finally, in the generalization stage, researchers can apply the cross-validated model to an entirely new dataset and evaluate the fit of the predictive model.

In their review of the literature, the authors also identify various challenges that need to be addressed when implementing a predictive model using brain states. Among them, the authors discuss the need for large samples that can support more rigorous statistics, developing predictive models instead of relying on correlations between baseline measures and outcomes, integrating findings across multiple imaging modalities, and involving plausible, alternative interventions when making recommendations related to improving a person’s education, skills or health.

Finally, that authors point out that although the use of neuromarkers to predict behavior may be of great interest for clinical and educational applications, there are many ethical and societal issues to consider. Most notably, the authors express concerns over the possible use of predictive models to limit support for individuals at higher risk of failure. In addition, since brain measures may be overly valued compared to behavioral and social factors, it will be important for researchers to address the limitations of the predictive models they develop.

In summary, the authors review evidence of predictive models using brain states to predict behavioral outcomes, and provide strategies for developing these models, while also discussing limitations and challenges that will need to be addressed by future studies.


*HPEN News*

HPEN director, S. Cacioppo, has been recognized as an APS (Association for Psychological Science) Fellow. According to the APS web site: “Fellow status is awarded to APS Members who have made sustained outstanding contributions to the science of psychology in the areas of research, teaching, and/or application.”

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